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SERA MAGNESIUM IN COMPLICATED AND UNCOMPLICATED TYPE 2 DIABECTICS IN OSOGBO, NIGERIA.

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ABSTRACT

Perturbations in magnesium have been observed in relation to human diseases, and in so many countries, magnesium depletion have been found to have a negative impact on glucose homeostasis, and insulin sensitivity as well as on the development of complications in type 2 diabetic patients. Therefore, the aim of this study was to compare serum magnesium concentration of type 2 diabetics and healthy controls in Osogbo, Nigeria. Serum Magnesium concentrations were determined in sera of 53 type 2 diabetics (25 with vascular and 28 without vascular complications) and 50 age- and sex-matched healthy controls using Atomic Absorption Spectrophotometric technique. Mean (±SD) sera magnesium concentrations of the diabetics (0.75±0.14) were found not to be significantly lowered. No significant difference ($p>0.05$) was also observed between the magnesium level of both complicated and uncomplicated groups of type 2 diabetes when compared to healthy individuals. However, an inverse correlation was observed between the fasting plasma glucose of the diabetes and the element under study. Therefore low sera magnesium concentrations and poor magnesium status are not common in type 2 diabetics in Osogbo Nigeria.

KEYWORDS: Type 2, Diabetes Mellitus, Magnesium, Complicated, Uncomplicated

INTRODUCTION

Diabetes mellitus (DM) is an endrocrinological disease (Evliyaoglu *et al*., 2004) of carbohydrates metabolism that is characterized by hyperglycemia and glycosuria resulting from dysfunction of pancreatic beta cells and insulin resistance (Khan and Safder, 2003). Many factors like hereditary, age, obesity, diet, sex, hypertension sedentary lifestyles, socio-economic-status and various stresses have been implicated in the etiology of diabetes mellitus.

About 170 million people are being afflicted worldwide with the disease and it's expected to be more than double by 2010 (McCarthy and Zimmet, 1997). About 1-7% of the whole Nigerian populace is having the disease, with over 90% of these being type 2 DM (Fabiyi *et al.,* 2002) and the prevalence rate among high, and low socio-economic groups of a small Nigerian population was as high as 23.4% band 16% respectively while, 18.9% of the same populace were unaware of their diabetic problem (Nwarfor and Owohoji, 2001).

Direct association of trace elements and macro elements with DM has been observed in many research studies (Nourmohammadi *et al.,* 2000). Insulin action has been reported to be potentated by some trace elements (Candilish, 2000), especially magnesium (Mg) which is a cofactor in the glucose transporting mechanism of the cell membrane and various enzymes in carbohydrate oxidation (Laughlin and Thompson, 1996). Mg is also involved at multiple levels in insulin secretion and binding and also enhances the ability of insulin to activate tyrosine kinase (Sur ez, 1993). Therefore Mg depletion has been postulated to have a negative impact on glucose homeostasis and insulin sensitivity in patients with type 2 DM (Nadler *et al*., 1993), as well as on the evolution of complications such as retinopathy, thrombosis and hypertension (Walti *et al.,* 2003).

Moreover, low serum Mg has been cited as a strong independent predictor of the development of type 2 DM in white subjects (Kao *et al*., 1999). And although, low serum Mg concentrations in diabetics have been found in several European and Asian countries (including USA), but Africa, especially Nigeria lack data to this fact. Therefore the aim of this study was to compare serum Mg concentrations of patients with type 2 diabetes and healthy controls in Nigeria.

Table 1
Clinical characteristics of 53 type 2 diabetics in the study, divided into two groups: with vascular diseases (group1, n=28) and without vascular diseases (group 2, n=25).

Characteristics	group1	group 2	f-value	p-value
Men / Women	12 / 16	7 / 18		
Age (yrs)	57.36 ± 10.73	57.08 ± 11.21	0.333	>0.05
Diabetes duration (yrs)	3.96 ± 2.22	2.32 ± 2.17	0.009	<0.05
FPG (mmol/L)	9.12 ± 1.93	4.62 ± 0.91	0.012	<0.05
SBP (mmHg)	117 ± 14.10	112 ± 11.20	0.010	<0.05
DBP (mmHg)	73 ± 9.50	70 ± 8.38	0.122	>0.05
Medication [Number (%) of subjects]				
Insulin	06 (21.43%)	Nil		
Oral-hypoglycemic	20 (71.43%)	09 (36%)		
Insulin + Oral-hypoglycemic	02 (7.14%)	06 (24%)		
Diet	Nil	10 (40%)		
Traditional medicine	Nil	04 (16%)		
Smoking Habitués [Number (%) of subjects]				
Smoking	19 (67.87%)	15 (60%)		
Not smoking	09 (32.14%)	10 (40%)		
Complications [Number (%) of subjects]				
Hypertension	10 (35.71%)	Nil		
Retinopathy	03 (10.71%)	Nil		
Nephropathy	06 (21.43%)	Nil		
Arteriosclerosis	04 (14.29%)	Nil		
Foot diabetic	05 (17.86%)	Nil		

MATERIALS AND METHOD

This study was conducted on a total of one hundred and three subjects from Osogbo (Longitude 4^0 33^1 E, latitude 7^0 46^1 N), south west Nigeria. This study was conducted between 2006 and 2007.

The base line test population consisted of fifty-three patients (19 men and 34 women) with type 2 diabetes mellitus (mean age 57.42 ± 10.43) diagnosed according to WHO standard (WHO, 1999). 52.8% of these subjects were attending diabetes clinic and with no vascular complication due to the disease at the State Specialist Hospital Osogbo while, 47.2% of the subjects were hospitalized due to vascular complications of the disease at the same hospital. The control group consisted of fifty healthy sex-and-age matched among the hospital staff and blood donors with no clinical or laboratory disorder.

Informed and written consent were obtained from each subjects before being recruited into the study. Because loop diuretics were associated with higher urinary Mg excretion (Walti *et al*., 2003), subjects taking loop diuretics or receiving mineral supplements of any form in the last one month were excluded from this study.

Overnight fasting blood samples were collected aseptically via venipuncture from each subject for fasting plasma glucose (FPG) and serum magnesium determination. FPG was estimated using glucose-oxidase method, while serum magnesium was estimated using flame atomic absorption method.

Statistical analysis is performed with paired sample 't' test by SPSS statistical package and the level of significance is set at $p<0.05$.

RESULTS

The clinical data of the test group (type 2 diabetics) were as presented in Table 1 the patients are divided into two groups according to the presence (group 1, n=25) or absence (group 2, n=28) of vascular complications. FPG, diabetes duration and systolic blood pressure (SBP) significantly higher ($p<0.05$) in group 2 subjects, while diastolic blood pressure (DBP) shows no significant difference ($p>0.05$).

Mean (±SD) serum magnesium concentration were non-significantly ($p>0.05$) lowered in type 2 diabetics (0.75 ± 0.07) than in controls (0.85 ± 0.14). Group 2 patients showed a non-significant ($p>0.05$) higher value than group 1 which has a lowest and also a non-significant ($p>0.05$) concentrations as compared to healthy controls (group 3) (Table 2).

Magnesium concentrations showed a negative correlation in both groups (group 1, $r = -0.879$ $p = 0.03$ and group 2, $r = -0.66$ $p = 0.09$) when compared with FPG, but a positive correlation ($r = 0.61$ $p = 0.07$) with non-diabetes healthy individuals.

Table 2
Sera magnesium concentration (mmol/L) in diabetic adult (N= 53) with vascular disease (group 1, n= 25) and without vascular disease (group 2, n= 28), and in healthy controls (group 3, N=50).

Group	Mg concentration (mmol/L)	Bonferonni's comparism with other groups		
		1	2	3
1	0.72 ± 5.60	--	>0. 05	>0. 05
2	0.78 ± 6.42	>0. 05	--	>0. 05
3	0.72 ± 0.14	>0. 05	>0. 05	--

DISCUSSION and CONCLUSION

Trace elements are uniquely required for growth and maintenance of life and health. Lack or inadequate supply of each nutrient produce functional impairments or can results in disease (WHO, 1996) Mg is mainly an intracellular cation, with less than 1% of total body content present in the extra–cellular fluid. The Mg concentration in serum represents not more than 0.3% of total body magnesium (Shills, 1998). Nevertheless, serum or plasma Mg measurement is the most readily available and widely used test of Mg status in humans. (Gums, 1987). Hormones that help to regulate Mg levels in the body include calcitonin, parathyroid hormone, and insulin. Insulin administration or insulin release in response to an ATPase pump .Mg also as an integral part of the activated MgATP complex regulating protein kinases, is directly involved in the control of glucose metabolism (Maher, 1998).

The result of this study revealed that there was a reduction in the Mg concentration of type 2 diabetes patients and though being lowest in patients with vascular complications than those without vascular disease due to diabetes though, this reduction does not reach any significance. This was consistent with the work of Nsonwu, *et al*., (2006) who also reported a non-significant lower Mg values in serum of diabetics from Calabar (south-south Nigeria) when compared to their non-diabetes healthy individuals. However, a

striking contrasts finding from Caucasians who have all reported significantly lower Mg concentrations in the body of their diabetics as compared to their non-diabetes individuals (Nadler, *et al*., 1992, Walti, *et al*., 2003,Nourmohammadi, *et al.*, 2000*).*

The negative correlation seen between Mg values and FPG of group 1 and 2 diabetics in this study was also in consistent with earlier study of McNair, *et al.*, (1982) who demonstrated an inverse relationship between plasma Mg levels and fasting blood glucose levels in diabetes, but in contrast with the works of Anetor, *et al., (*2002) who demonstrated an that plasma trace elements concentrations were not dependent on the degree of glucose control as determined by correlations analysis between glycated hemoglobin(HbAic) and the metal levels.

The mechanism of hypomagnesaemia in diabetes still remains unresolved but there is enough evidence to suggest that Mg levels drop in the course of recovery from ketoacidosis, during insulin therapy or with severe retinopathy or proteinuria (Nourmohammadi, *et al*., 2000). Increased urinary Mg excretion has also been reported in hyperglycaemia, osmotic action and glycosuria thereby, contributing to hypomagnesaemia seen in diabetes (Nsonwu, *et al., 2006*).

In this study, we have demonstrated that the low Mg status seen in type 2 diabetics in Osogbo, Nigeria is not of any significance. And because Mg depletion has a negative impact on glucose homeostasis and insulin sensitivity in diabetic as well as on evolution of complication such as retinopathy, thrombosis, dislipidaemia and hypertension (Nadler, *et al*., 1993, Mather, *et al*., 1982, Walti, *et al*., 2003, Seelig, 1989), it may therefore be prudent in medical practice to periodically monitor the Mg status of diabetics as dietary supplementation of the mineral should be considered in cases of low serum Mg concentration.

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